24. exp.

$$y = y_0 e^{kt}$$

3 hr	10,000
5 hr	40,000
0 hr	? = y_0

$$k = \frac{\ln 4}{2}$$

① $10{,}000 = y_0 e^{k\cdot 3}$

② $40{,}000 = y_0 e^{k\cdot 5}$

$$\frac{\#2}{\#1} = 4 = e^{2k}$$

solve for k

$$\ln 4 = 2k$$

$$10{,}000 = y_0 e^{\frac{\ln 4}{2}\cdot 3}$$

solve for y_0

$$y_0 = \frac{10{,}000}{e^{\left(\frac{\ln 4}{2}\cdot 3\right)}}$$

$$y_0 = 1250$$

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44. a) $y = y_0 e^{kt}$ $\quad k = r = 1$ (100%)

a) $y = y_0 e^{t}$ $\quad dt = \dfrac{\ln 2}{k}$

b) $\dfrac{\ln 3}{1} = 1.09$

c) $y = y_0 e^{1}$

$$y = y_0 \cdot 2718$$

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rule of 72 : $\frac{70}{r\%} = \frac{72}{\text{rate } \%} = $ double time

$\text{rate } \% = \frac{72}{d.t.}$

$$\frac{\ln 2}{k} = \frac{.69}{k} \cdot \frac{100}{100\%}$$

$$= \frac{69}{k} \doteq \frac{70}{k} \doteq \frac{72}{k}$$

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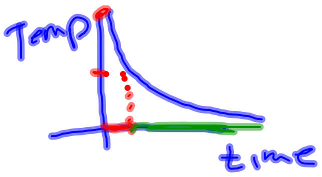
6.4 newton's law of cooling

$$\frac{dT}{dt} = -k\,(T - T_s)$$

the hotter the liquid . . . the ~~faster it cools~~



T = Temp

t = time

T_s = Temp of surroundings

k = cooling constant (rate)

(constant)

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Solve $\frac{dT}{dt} = -k(T - T_s)$ $\int \frac{du}{u} = \ln|u| + c$

find T

sep. var. $\int \frac{dT}{T - T_s} = \int -k\,dt$

$e^{\ln|T - T_s|} = e^{(-kt + c)}$

plug in initial conditions $\longrightarrow$ $T - T_s = e^{-kt} \cdot e^{c} = c e^{-kt}$

$t = 0 \quad T = T_0$ $T = T_s + ce^{-kt} = \boxed{T_s + (T_0 - T_s)e^{-kt}}$

$T_0 - T_s = ce^0$

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Newton's Law of Cooling

$$T = T_s + (T_0 - T_s)e^{-kt}$$

Ex 6 $T_0 = 98$ $T_s = 18$ when $t = 5$ $T = 38$

1st find k

$38 = 18 + (98 - 18)e^{-k \cdot 5}$ $t = ?$ $T = 20$

$\frac{20}{80} = e^{-k \cdot 5}$ $20 = 18 + (98 - 18)e^{-.2773t}$

$.2773 = \frac{\ln \frac{1}{4}}{-5} = -k \cdot \cancel{5}$ $\frac{2}{80} = e^{-.2773t}$ solve for t

$13.3 = \frac{\ln \frac{1}{40}}{-.2773} = \cancel{-.2773}t$

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radioactive decay

$$y = y_0 e^{-kt}$$

half life

$$H = \frac{\ln 2}{k}$$

$$y = y_0 e^{-\frac{\ln 2}{H} \cdot t}$$

$$k = \frac{\ln 2}{H}$$

$$y = y_0 \left(e^{-\ln 2}\right)^{\frac{t}{H}}$$

$$y = y_0 \left(\frac{1}{2}\right)^{\frac{t}{H}}$$

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C_{14} $H = 5700$ yrs

10% C_{14} decayed

90% remains

$$y = .90\cancel{y_0} = \cancel{y_0}\left(\frac{1}{2}\right)^{\frac{t}{5700}}$$

solve for t

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